Research Article
Volume 10:1, 2021

Expert Opinion on Environmental Biology

Open Access

Petroleum Industry Cellulose Biomasses Polymers Fabricating and Fabricating Unit Design

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Introduction:

As we approach an age of deeper discoveries in hostile environments, we need to either improve on existing industry or design new ones in order to meet the technological demands for success.

Wide ranges of naturally occurring polymers derived from renewable resources are available for material applications (cellulose, starch, CMC, etc.). Natural resources like Baggas, Musket and wheat from different areas in Sudan are the research investigation interest.

Five basic properties are usually defined by the industrial program and monitored during fabricating: Rheology, density, and fluid density, and fluid loss, solid content and chemical properties. If the fluids properties are uncontrolled, there will be very serious risks and hazards in terms of economic and safety.

This study is focuses on the Isolation and Utilization of Polymers and suggests Cellulose Biomasses Polymers Fabricating Unit Design from Local materials for industry and especially for petroleum industry applications in order to increase the national income by adding a natural resource and to decrease the costand dependency on the imported polymers from abroad.

Problems Statement: -

The aim of this study is to generate tools for utilizing Cellulose Biomasses Polymers Fabricating Unit Design. This research focuses on the industrial fabricating and industry unit design of Isolated Polymers from Local materials for industrial applications in order to increase the national income by adding a natural resource and to decrease the cost and dependency on the imported polymers from abroad.

Research Objectives:

1. To isolate, convert, characterize pure cellulose from cheap and available materials such as: Baggas, Rice Husk, Wheat Stalk, Meskeet, Ground nut husk etc.
2. Examine the behavior of the conversion isolated polymers in normal and hard conditions.
3. Study the impact of the produced polymer on the oilfield.
4. Material Balance investigation, optimization and energy control processes.
5. Design suitable facilities to produce polymer for oil industrial uses.
6. Design the necessary treatment facilities for the raw material and polymer production.
7. Optimize the consideration of safety precaution and environmental impact of the project.
8. Computer Program Simulation using HYSIS
9. Economical analysis and evaluation

Literature Review

During the last century and a half, new families of engineering materials known as polymers have been discovered and produced, Polymers are at the basis of important industrial goods. Their rapid growth in production is caused, beside social factors, by the necessity to replace classical materials.

In industrial engineering many types of polymers were used in the process dated back to 1930 to improve fluids properties and to avoid several compromised during operations [1][2].

In industry, the quality of added material is an expensive and complicated operation compared with other activities in producing program [3].

Polymers are natural, modified natural biologic or synthetic chemicals that are found in a wider range of products than are clays. Natural and modified polymers such as starches, cellulose, xanthium and guar gums have been used since ancient times to build viscosity and add lubricity to water [4].

Simulations of Cellulose (Bergenstråhle, 2010) method study the molecular level why cellulose is insoluble. They calculated the free energy required to separate solvated oligomers of glucose, cellobiose, cellotriose, and cellotetraose in different orientations. The important finding from their work was that inter- oligomer hydrophobic association and hydrogen bonding are responsible for the insolubility of cellulose. Specifically, they found that there is a high entropic cost for hydrating glucose hydroxyl groups, and there is no increase in configurational entropy of a short cellulose chain in going from the crystalline to the dissolved state. Taken together, these results clearly show why the crystalline state is strongly favored over the solvated state [5].

These compounds are in many organic chemical compositions but all are of a chemical bond type called chains, which refers to the way the individual molecules link together. Polymers are classified by the chain's shape and the number of repeating chains. The type of chain is what causes different polymers to have different effects.

Polymers can be used by themselves but are generally used by adding them to a base fluid consisting of conditioned water and hi-yield paste, which is already mixed and yielded to the desired viscosity. Polymers in oil industry are added to inhibit clay and shale, add lubricity, prevent balling, build viscosity, and control water loss, depending on operation specific conditions [6].

The rheological properties of the fluid are of great importance where it affects the operation running condition. Rheological behavior of fluids is vital in their proper selection for any well. Rheological properties of drilling muds are important because they are used to characterize properties of the mud such as its well cleanses, erosion preservation, cutting material removal, hydraulic calculation, and pump system [7].

The reactions between clays and polymers will depend on a number of factors such as Molecular Weight, and Adsorption onto the Clay [8].

An extensive classification of fluids as water - base, oil – base and gaseous fluids comprises of water, bentonite and multitude of additives. Additives are a vital component in the program and the success of industrial operation depends with a high degree on it Bentonites are used worldwide as drilling fluidities. Their main functions are the viscosities of the mud in order to reduce the fluid loss to the formation [9] [10].

Water based fluids are the most widely used in operations because they are available, minimal environment impact and low cost [11, 12].

Additives is a vital component in the program and the success of industrial operation depends with a high degree on it [13]. Depending on operation condition for off/on-shore the additives used mostly are same in composition [14].

If the fluids properties are uncontrolled, there will be very serious risksand hazards in terms of economic and safety [15].

In another study, carboxymethylcellulose (CMC) samples with different degrees of substitution were obtained from Eucalyptus globulus pulps. Formic acid-peroxyformic acid medium (Milox delignification) was used to treat the samples which was also subjected to totally chlorine free bleaching. In order to assess the rheological behavior of the synthesized materials, their properties (rheological behavior, solubility and molar mass) were determined and examined in relation to their total degree of substitution [16].

In recent decades, as modern industry is progressing, the treatment of industrial wastewater has become an urgent need for environmental protection. Large number of industries propagates colored effluent containing dyes and pigments, which are considered non-biodegradable and bio-accumulative [17].

Biopolymers have attracted much interest in the application of metal removal as they are safe because they do not generate solid waste, and they are biodegradable. Methods to increase the adsorption of heavy metal on nano-fiber materials include enlarging the surface area, altering the surface charge, and surface modification with functional groups. Furthermore, in recent years, polymer composites and Nano composites have attracted great attention as excellent materials for removal of heavy metals as well as for treatment of wastes [18].

Lignocellulose biomass contains polymers of cellulose, hemicellulose and lignin bound together in a complex structure, apart from the three basic chemical compounds lignocellulose contains, water and minor amounts of proteins, minerals and other components, to find an optimized pretreatment for extract the three main components at the same time using separation steps that don’t degrade any of the products during the process.

A way to avoid the degradation of hemicellulose during the organosolv process with EtOH/water mixture is doing a prehydrolysis before, where the hemicellulose is dissolved in the water.

The first step in the fractionation of lignocellulose biomass into fuels or chemicals typically involves a biomass pretreatment step, which aims at making the cellulose more easily hydrolyzed by removing the hemicellulose, increasing the surface area and porosity but reducing the crystallinity of the cellulose the most important pretreatments can be seen as follows:

Mechanical Pretreatment: The reduction of particle size is essential for the fractionation to make material handling easier and to increase surface/volume ratio this can be done by chipping, milling or grinding.

Chemical Pretreatment: Include Liquid hot water, Acid hydrolysis, alkaline hydrolysis, Organosolv process, Steam explosion [19].

Chemical reactor is an enclosed volume in which a chemical reaction takes place. In which is one of the classic unit operations in chemical process analysis. Normal operating expenses include energy input, energy removal, raw material costs, labor, etc. Energy changes can come in the form of heating or cooling, pumping to increase pressure, frictional pressure loss or agitation.

There are three idealised models used to estimate the most important process variables of different chemical reactors:

1. Batch reactor model,
2. Continuous stirred-tank reactor model (CSTR)
3. Plug flow reactor model (PFR).

Many real-world reactors can be modeled as a combination of these basic types. Key process variables include:

1- Residence time (t)
2-Volume (V)
3- Temperature (T)
4-Pressure (P)
5-Concentrations of chemical species (C1, C2, C3 ... Cn)
6- Heat transfer coefficients (h, U)

Chemical reactions occurring in a reactor may be exothermic, meaning giving off heat, or endothermic, meaning absorbing heat. A tank reactor may have a cooling or heating jacket or cooling or heating coils (tubes) wrapped around the outside of its vessel wall to cool down or heat up the contents, while tubular reactors can be designed like heat exchangers if the reaction is strongly exothermic, or like furnaces if the reaction is strongly endothermic. [20]

Design facilities to produce polymer for industrial uses need deep research and investigation, but System design components require close attention by:

Reactor configuration. Reactor configuration is determined by the reaction scheme for making the product of choice with the desired molecular architecture. Living polymers, for example, maintain their narrow distributions as long as all chains have the same residence time, which can be achieved in a well-mixed batch reactor or a plug-flow reactor.

Reactor conditions. Polymer properties, like catalyst activity, also vary with temperature and with the level of chain-transfer agent. Reactor conditions depend on the reactor configuration. Some reactors are vulnerable to temporal or spatial variations, the products of which are really composites of chain populations produced at various times or various locations in the reactor.

Heat removal. The heat released by many polymerization reactionsof commercial interest is usually more than a simple heat-removal mechanism, such as a jacket or a coil, can handle. As a result, we need to be creative in developing mechanisms that do not significantly increase capital cost — for example, an external heat exchanger with a recirculation pump. The high viscosities of most polymerization systems, and the corresponding low heat-transfer coefficients, make this task particularly challenging.

Fluid mechanics. Polymers and their mixtures do not always behave like Newtonian fluids. This issue is particularly critical in a monomer-injection system, where fluids with very different properties and temperatures must mix rapidly to avoid creating polymer populations with the wrong properties.

Mass-transfer limitations. Mass-transfer limitations are common in heterogeneous systems, because the monomer and other components must diffuse through a continuous phase in order to reach the discrete phase where polymerization takes place. Systems that appear to be simpler can have these limitations as well. For example, if the monomer is volatile and a headspace exists in the reactor, the monomer may accumulate inthe headspace, lowering its rate of consumption in the liquid phase.

Thermodynamic constraints. Even if only one phase is expected to exist in the reactor, process operators and engineers should stay vigilant to ensure that a second phase does not form. Running the reactor at a very low pressure risks the formation of a vapor phase. Running at a very low temperature risks coating the reactor internals with polymer. Neither of these is a welcome sight, especially the latter.

Process dynamics. In continuous processes, the more complex the product sequence, the more important it is to manage a quick transition between polymer grades. Some grades might be completely incompatible because of the markets to which they are destined, so the need to avoid cross-contamination puts an additional stress on the manufacturer, and highlights the need for efficient product-grade-transition schemes.

Reactor stability. The thought of releasing increasing amounts of energy from a reactor brings to mind the possibility of multiple steady states, sustained oscillations, chaotic behavior, and the danger of a reactor runaway. Some people believe these problems are only concerns of academia, but they can easily lead to trouble. A good reaction system design avoids operating a reactor too close to a limit point, for example, where a small disturbance causes a rapid deviation from the desired steady state.

The conversion of raw polymers into finished products involves a seriesof steps. The first step consists of mixing additives into the polymer to achieve the required modification to the properties of the raw polymer. The second stage is to create the desired shape. Forming can be conveniently divided into two-dimensional forming. In most manufacturing there will be a number of finishing steps but the advantage of polymer processing over manufacturing with more traditional materials is that there are opportunities for cost savings through minimizing finishing processes [21].

Materials and Methods

The Methodology of this research project can be described as below:

1- Samples Collection, Samples Preparation, Polymers Isolation and testing the chemical properties of the extracted polymers.

2- Examine the behavior of the conversion isolated polymers in normal and hard conditions.

3- Study the impact of the produced polymer on the oilfield.

4- Investigation Material Balance, optimization and energy control processes.

5- Design facilities to produce polymer for industrial uses.

Suitable facilities for Design and produce polymer for industrial uses.

The conversion of raw polymers into finished products involves a series of steps. The first step consists of mixing additives into the polymer to achieve the required modification to the properties of the raw polymer. That need optimization the alkalization and etherification reaction parameters like concentration of NaOH, concentration of monochloroacetic acid, reaction time and temperature to produce CMC with suitable degrees of substitution. Which will be made in the Continuous Stirred Tank Reactor (CSTR).

6- Built all the necessary treatment facilities for the raw material and polymer production (Mechanical Pretreatment Chemical Pretreatment|).

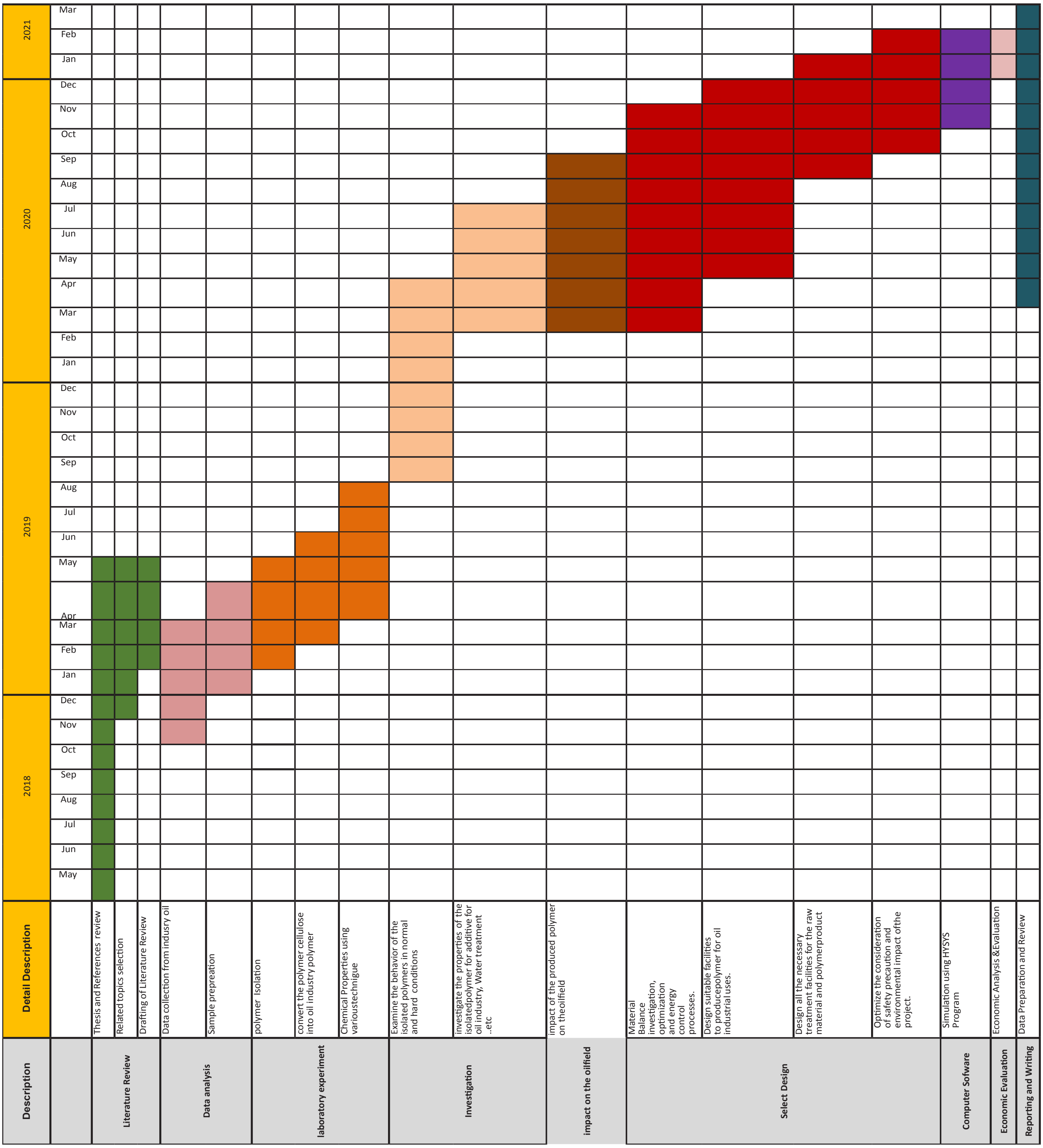
7- Optimize the consideration of safety precaution and environmental impact of the project.

8- Economical analysis and evaluation

9- Computer Program Simulation using HYSIS.

Time Table: -

The projected period for PhD work is three years. Each activity is allocated certain time. Table 1 shows the time allocated for each activity.



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